Geophysical Research Abstracts
Vol. 21, EGU2019-7094, 2019
EGU General Assembly 2019

Simulating landslide generated tsunamis in Palu Bay, Sulawesi, Indonesia

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On 28 September 2018, a strong earthquake of Mw 7.4 hit the Northern part of Sulawesi, Indonesia. Despite the fault mechanism being predominantly strike slip, a large regional tsunami was generated, affecting mostly Palu bay area almost immediately after the earthquake. Arrival times of less than 5 minutes were observed, Palu city, located at the end of the bay, experienced enormous devastation by earthquake, tsunami inundation, and soil liquefaction. The observations suggest that submarine landslides contributed considerably to the tsunami. In a number of surveys after the event, conducted by various organizations, the impact of the waves as well as the coastal subsidence was investigated and several locations of potential landslides in the bay area were identified.

Based on the currently available and published data, we simulate tsunamis generated by landslides in six locations in the bay and investigate the dependency of the obtained wave height on slump volume and timing of the different landslide components. Landslide dynamics are considered in the framework of a two-layer system involving water and landslide material. The problem is formulated both in Cartesian coordinates and in a generalized form relying on curvilinear boundary-fitted coordinates. An essential element of landslide dynamics is the account for the non-hydrostatic pressure component defined by the solution of the nonlinear dispersive Boussinesq equation.

Our numerical implementation for curvilinear coordinates uses the second-order difference splitting scheme with restriction on the grid size only imposed by advection, and includes a module for computing wetting and drying in the shallow zone. We present the results of an extensive series of numerical experiments simulating the physical and energetic characteristics of coastal wave dynamics generated by a landslide.